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The Importance of Orthostatic Radiography in the Management of Thoracolumbar Fractures: Case Report

A importância do raio-X em ortostase no manejo das fraturas toracolombares: relato de caso

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Abstract

Patients who are victims of traumatic injuries in the spine are evaluated by radiological protocols, as recommended by Advanced Trauma Life Support (ATLS), including a computed tomography (CT) scan with the patient in the decubitus position. Spine fractures considered *stable* with initial nonoperative management should be further evaluated with a standard simple plain radiograph in orthostasis and/or a magnetic resonance image (MRI), to exclude any associated ligament injury and avoid neurological damage caused by occult instabilities. We present an illustrative case with an injury diagnosed through orthostasis X-ray to discuss its importance in the management of thoracolumbar fractures.

Keywords

- thoracolumbar fracture
- orthostatic X-ray
- conservative management
- instrumented fusion

Introduction

Traumatic fractures of the thoracolumbar spine, specifically the thoracolumbar junction (T10–L2), represent the most affected site of spinal injuries in most studies due to the inherent biomechanical characteristics of the area—the junction of a mobile lumbar spine with a rigid thoracic spine.[1] The first radiological evaluation of these patients is usually made using simple plain radiographs. When a computed tomography (CT) scan is performed, up to 99% of diagnostic accuracy in detection of bone injuries can be achieved.[2] For this reason, CT scan is the most used and widespread radiological modality to diagnose spinal fractures.

The compression-type fractures of the AO Spine thoracolumbar classification system correspond to the majority of the injuries that affect the thoracolumbar spine; despite their high prevalence, there remains some controversies about the best treatment option (non-operative versus operative) for patients neurologically intact (N0) with *burst* fractures (currently classified as A3, or incomplete burst fractures, and A4, or complete burst fractures).[3,4] In this context, the final treatment is influenced by the anatomical characteristic of the fracture (degree of wedging of the vertebral body, degree of vertebral body comminution and segmental kyphosis), clinical status (pain or functional disability) and also surgeon's preferences.[5] In the absence of neurological damage,

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CT scan with the degree of canal compression and severe local kyphosis are potential characteristics related to failure of nonoperative management. Potential injury of the posterior ligamentous complex (PLC) may also influence the long-term outcome due to progressive kyphosis, leading to segmental deformity, pain, and neurological deterioration.[6]

Fractures considered stable, such as compression fractures and mild burst fractures (AO Spine type A) rarely need additional radiological evaluation after the CT scan.[7,8] Their management consists in thoracolumbar orthoses and analgesics that enable the patient to bear load of their own body weight during daily activities until vertebral healing.[6,9] However, some patients diagnosed with A3 and A4 fractures should not have be considered to have stable injuries when, in fact, they have an occult B2 fracture (AO Spine classification system – distraction fractures associated with posterior ligamentous complex injury),[10] which was not initially detected in the patient's exams in dorsal decubitus (without axial load) due to some postural reduction. We present an illustrative case to emphasize the importance of orthostatic simple, plain radiographs in detecting a hidden spine instability that had not been found in the conventional CT scan and how that fact impacted the case.

Methods

A 42 year-old male patient was admitted to the emergency department after a fall from a height of 10 m. Besides lacunar amnesia due to mild head injury, no other neurological function was affected—neurologically intact (N0). A spine CT scan revealed a thoracolumbar fracture at T12–A3 and L5–A0.[10]

Fig. 1 Sagittal computed tomography.

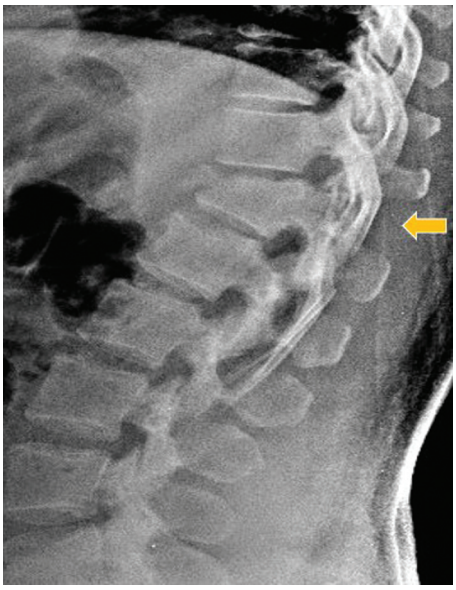

Fig. 2 Orthostatic simple, plain radiograph.

►**Fig. 1** shows as sagittal CT image of an incomplete burst fracture (A3) at T12 without spinal dislocation (arrow).

Although the proposed initial treatment was nonoperative, a standing thoracolumbar simple, plain radiograph was performed and reported a clear increase of the interspinous distance (T11–T12), segment kyphosis (Cobb > 25°), and vertebral segment wedging (> 50%), along with severe back pain during the exam.

►**Fig. 2** shows an orthostatic simple plain lateral thoracolumbar spine radiograph with a clear spinal dislocation between T11 and T12, with increasing distance of the spinous process (arrow). This injury should be better classified as a B2 injury with an A3 component of T12.

Based on this, a ligamentous failure was inferred, and we reclassified the injury as B2.[10] A thoracolumbar instrumented fusion was indicated and performed without complications. The procedure was uneventful, and the patient was discharged home 4 days later. After about 3 months, the patient returned to his job, without restrictions or additional medication for pain control.

►**Fig. 3** shows the postoperative CT scan of the reconstruction with a T10–11–12-L1 instrumented fusion with pedicle screws.

►**Fig. 4** shows the preoperative sagittal CT scan with a kyphosis angle between T11 and L1(red lines) of 10.9° in supine position.

►**Fig. 5** shows the orthostatic simple, plain lateral thoracolumbar spine radiograph with an increasing angle of the local kyphosis to 25.5° from T11 to L1 (red lines).

Discussion

Clinical instability of the spine after a trauma occurs when the spinal ligaments and bones lose their ability to maintain normal alignment between vertebral segments while under

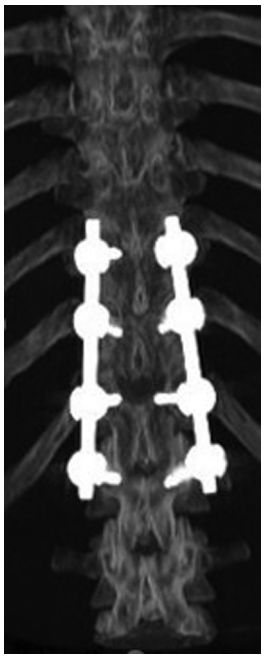

Fig. 3 Computed tomography reconstruction.

Fig. 4 Preoperative sagittal computed tomography scan showing kyphosis.

a physiological load. Instability can lead to further injury, pain, or deformity, and can require further surgical stabilization.[11] Injuries to the posterior ligamentous complex (PLC) are often missed and may cause unexpected neurological deficits and complications. The diagnosis can be achieved using indirect signs of spinal radiographs and CT when the cuts are thinner (1–2 mm) with splaying of the spinous processes, avulsion of the superior or inferior margins of the spinous processes, widened facet joints, empty ("naked") facet joints, perched/dislocated facet joints, and vertebral translation/rotation, or with direct view of PLC injury using MRI.[4,12,13]

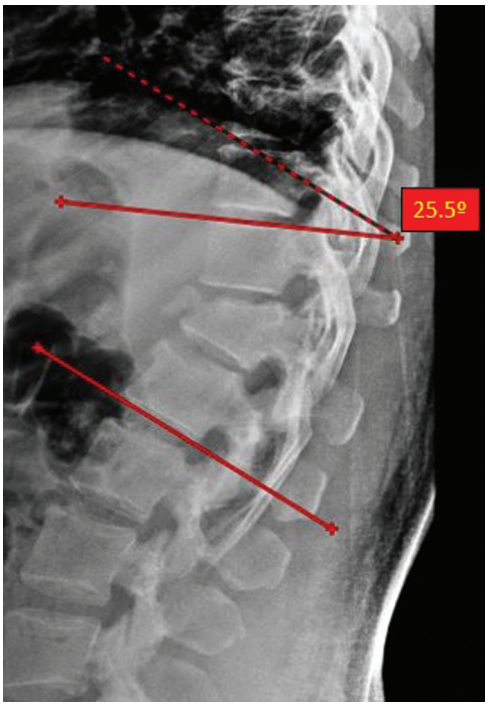

Fig. 5 Orthostatic simple, plain radiograph showing lateral local kyphosis.

The use of the simple plain radiographies in the orthostatic position may be useful to obtain additional information for the evaluation of stability, especially at the level of controversial fractures.[14,15] Current trauma protocols are based in radiographs and decubitus CT scans that limit the visualization of soft tissues; therefore, PLC injuries may not be detected.[16,17]

Magnetic resonance imaging is the gold standard for detection of soft-tissue lesions or those[18,19] involving the intervertebral disks and spinal ligaments.[20] It is also used to exclude occult injuries and helps to identify epidural space involvement or at the level of spinal cord.[1,21] The MRI protocol exam of the spine includes the sequences T1, T2, and short tau inversion recovery (STIR), especially the latter, which is particularly conspicuous to edema in the interspinous or supraspinous ligaments.[22] When MRI shows the rupture of the supraspinous ligament (SSL), one can infer PLC incompetence (signal *black-stripe* discontinuity).[23] The time interval defined as optimal between initial trauma and MRI should be less than 72 h. After that, the edema begins to reabsorb, and the hemorrhage reduces the sensitivity of imaging to reveal a ligament aggression. The hyperintensity at T2 is produced by edema or extravasation of blood into the injured extradural tissues, providing an excellent contrast medium and improving the definition of ligaments that are usually of low signal intensity on all imaging sequences.[24]

Some authors have proposed that injuries should be characterized as type A unstable when presenting segmental kyphosis values $\geq 25°$ and wedging of the vertebral body $\geq$ 50%—despite some criticism about their real significance in outcome.[21,25–27] They have also proposed that surgical intervention is considered in cases where a bone fragment

(posterior wall disrupted) causes a canal compression greater than 50% of the its diameter.[28–30]

Considering its simplicity and low cost, we propose that an additional exam in the orthostatic position is included in patient radiological evaluation for burst fractures that are considered for nonoperative management.[28–30] An evaluation in decubitus may not be sensitive enough to detect posterior ligament instability in minor injuries.[31] The radiograph has the great convenience of being a less expensive equipment that is available in any healthcare or trauma center.[18] Of note, for those patients in whom clear spinal instability is documented in static exams as well as for those with neurological deficits (N2, N3, N4), standing or sitting X-rays should not be indicated due to the risk of additional neurological deficit. Finally, in our opinion, in an ideal scenario, both MRI and orthostatic radiographies can provide useful information for deciding the best treatment option in neurologically-intact patients with burst fractures.

Conclusion

An additional simple orthostatic plain radiography for patients with type A fractures who have a burst fractures without neurological deficits and are considered for nonoperative management should be an effective, available, and safe strategy to identify unstable lesions not clearly detected by radiological images in the supine position. An MRI is also recommended to detect potentially occult ligamentous injury. Further studies are necessary to study the safety and efficacy of this radiological modality in the management of thoracolumbar fractures.

Conflict of Interests

The authors have no conflict of interests to declare.

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